REVISION OF THE TATE MOLLUSCAN TYPES — PART 3
LIMOPSIDAE, GLYCYMERIDAE, ARCIDAE, CUCULLAEIDAE

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[Read 10 June 1965]

SUMMARY.

Twenty-nine species of Tertiary mollusca in the Tate Collection of the Geology Department, University of Adelaide, have been redescribed. All but five of the species have restricted time-ranges, there being a significant difference both at the generic and specific level between Upper Eocene species and those of mid and late Tertiary age.

INTRODUCTION.

The paper is the third of the series in which the Tertiary mollusca in the Tate type collection in the Geology Department of the University of Adelaide are redescribed. These include all of Tate's primary types and mounted specimens to which he referred without necessarily figuring them. Where the holotypes are located elsewhere the following abbreviations have been used for their repositories:

N.M.V.	National Museum of Victoria, Melbourne.
M.U.G.D.	Melbourne University Geology Department.
Tas. Mus.	Tasmanian Museum, Hobart.

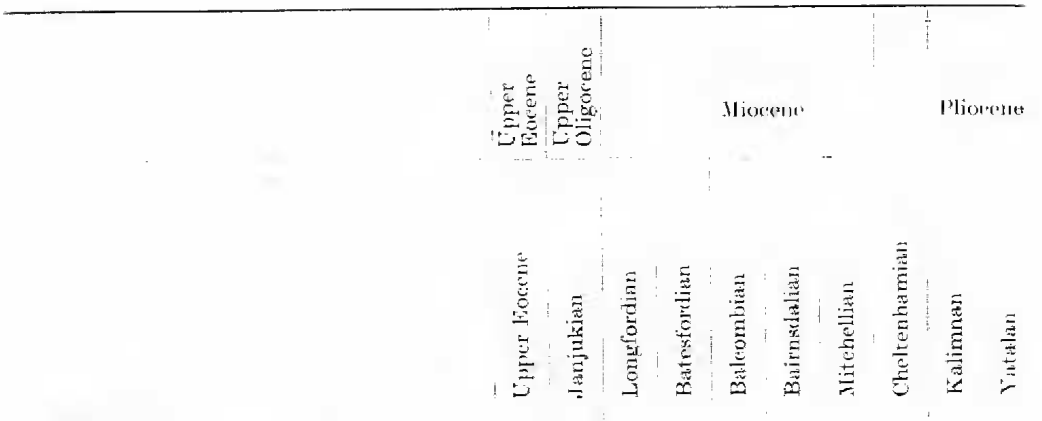
In determining the stratigraphic range of the species belonging to the four taxodont families only the specimens mounted in the Tate Collection have been taken into consideration. Where it has been possible to confirm the type locality from material available in the collection of the Geological Survey of South Australia, this has been done.

The time ranges of the species are tabulated in Table 1. No stage name has been used for the Upper Eocene, since two names, "Johannian" and "Aldingan" have been used in recent publications for the same microfaunal units of the Upper Eocene. The name "Yatalan" is included to designate the Pliocene fauna of the Dry Creek Sands underlying the Adelaide Plains (Ludbrook, 1963, p. 13).

The composition of both the Eocene and Miocene faunas is essentially that of warmer waters. *Arca*, *Cucullaearca* and *Cucullaea* are represented only in tropical faunas of the present day.

* Geological Survey of South Australia; published with the permission of the Director of Mines.

TABLE 1.



LIMOPSIDAE
- Limopsis beaumariensis
- Limopsis chapmani
- Limopsis maccoyi
- Limopsis morningtonensis
- Limopsis multiradiata

GLYCYMERIDAE
- Glycymeris (Glycymeris) cainozoica
- Glycymeris (Glycymeris) halli
- Glycymeris (Grandaxinea) granti
- Glycymeris (Grandaxinea) maccoyi
- Glycymeris (Grandaxinea) ornithopetra
- Glycymeris (Tucetona) convexa
- Glycymeris (Tucetona) decurrens
- Glycymeris (Tucetona) gunyoungensis
- Glycymeris (Tucetona) lenticularis
- Glycymeris (Tucetona) subtrigonalis

ARCIDAE
- Arca capulopsis
- Arca pseudonavicularis
- Arcopsis dissimilis
- Barbatia (Barbatia) consutilis
- Barbatia (Barbatia) limatella
- Barbatia (Barbatia) pumila
- Barbatia (Acar) celleporacea
- Barbatia (Acar) crustata
- Barbatia (Acar) simulans
- Barbatia (Cucullacarca) equidens
- Barbatia (Plagiarca) cainozoica
- Anadara interclathrata

CUCULLAEIDAE
- Cucullaea adelaidensis
- Cucullaea corioensis

Family LIMOPSIDAE

Genus LIMOPSIS Sassi, 1827

Limopsis beaumariensis Chapman

(pl. 1, figs. 10, 14, 15, 16)

1875. *Limopsis belcheri* McCoy, Prod. Pal. Vict., dec. 2, 26 (in part).

1911. *Limopsis beaumariensis* Chapman, Proc. Roy. Soc. Vict., **23** (2), 423, pl. 84, fig. 6; pl. 85, fig. 12.

1955. *Limopsis beaumariensis*; Ludbrook, Trans. Roy. Soc. S. Aust., **78**, 23, pl. 5, fig. 7.

Description. Shell subtrigonal, about as high as long, subequilateral, thick, moderately convex; umbo central, small, acute, incurved; dorsal margin short and slightly curved, both anterior and posterior margins gently curved, ventral margin curved; hinge line arched, with 7-9 posterior and 7-9 anterior teeth, ligamental area relatively short and narrow, ligament pit large and triangular; ornament of conspicuous slightly undulating primary riblets crossed and cancellated by concentric growth lines, in the juvenile stage the radials and concentrics are approximately equal, but in the later stages the concentrics are stronger than the radials; inner margin smooth, slightly concave; anterior adductor high and small, posterior adductor a little lower than the anterior, broadly ovate; pallial line entire, interior of shell inside the pallial line conspicuously radially striate.

Dimensions. Topotype T1023G length 21, height 22 mm.

Types. Holotype N.M.V. P12583; hypotypes A.U.G.D. T1023G, H (topotypes), T1030A, B.

Material. The species is represented in the Tate Collection by two specimens G and H from Cheltenham on tablet T1023, the other specimens on the tablet being *L. maccoyi*, and 7 specimens from "Gippsland Lakes" on T1030. Both tablets are labelled "*Limopsis belcheri* Adams & Reeve".

Type Locality. Beaumaris, Victoria (Cheltenhamian).

Stratigraphic Range. Cheltenhamian (Upper Miocene)* and Pliocene.

Limopsis chapmani Singleton

(pl. 1, figs. 1-9)

1875. *Limopsis aurita* McCoy, Prod. Pal. Vic., dec. 2, 23 (pars), pl. 19, figs. 5, 6, 6a-b, 7, *non Arca aurita* Brocchi.

1885. *Limopsis aurita* Tate, Pap. Proc. Roy. Soc. Tas. for 1884, 212 (*non* Brocchi).

1886. *Limopsis insolita* Tate, Trans. Roy. Soc. S. Aust., **8**, 134, *non Trigonocoelia insolita* Sowerby.

1886. *Limopsis aurita* Tate ibid. (*pars*) (*non* Brocchi).

1888. *Limopsis aurita* Johnston, Geol. Tas., pl. 32, fig. 7.

1897. *Limopsis insolita* Harris, Cat. Tert. Moll. Brit. Mus. 344 (*non* Sowerby).

1911. *Limopsis insolita* Chapman, Proc. Roy. Soc. Vict., **23** (2), 425-429, pl. 84, fig. 5; pl. 85, fig. 11.

1932. *Limopsis chapmani* Singleton, Proc. Roy. Soc. Vict., **44** (2), 296, pl. 24, figs. 12-14; pl. 25, fig. 16.

Description. Shell thick, obliquely ovate, inequilateral, convex, particularly near the umbo; umbo situated a little to the anterior, small, acute, incurved; dorsal margin curved, slightly shouldered, anterior and ventral margins rounded,

* Present opinion is that the Cheltenhamian is of Pliocene rather than Upper Miocene age.

posterior margin only slightly arcuate and a little produced ventrally, slightly concave below the hinge line in topotypes; hinge line arched, high, with 8 anterior and 8 posterior teeth, the anterior teeth usually more or less erect, straight and narrow, the posterior teeth short, wide and hooked; ligamental area long and high, ligament pit large, prominent, broadly triangular, with concave sides, encroaching on the hinge teeth. Ornament of numerous concentric growth lamellae, imbricating towards the ventral margin; between the ridges are fine, weak, irregular radiating grooves; inner margin smooth, broadly flattened; anterior adductor high, small, narrowly ovate, posterior adductor low, broad, somewhat quadrately ovate; pallial line entire, conspicuous, interior of shell inside the pallial line radially striate.

Dimensions. Topotype T1022A length 18, height 20, inflation (both valves) 11 mm.; T1032B length 28, height 30, inflation (both valves) 18 mm.

Types. Holotype M.U.G.D. 1317, paratypes M.U.G.D. 1318-9. Hypotypes A.U.G.D. T1022A, T1022E, T1025B, T1025C, T1025E, T1025H, T1032B, T1032C.

Material. The species is represented in the Tate Collection by three tablets: T1022, with 13 mounted specimens A-M in a growth series, labelled "*Limopsis insolita* G. B. Sowerby. Eocene, Spring Creek". These are topotypes of Singleton's species from Jan Juc Formation, Bird Rock Cliffs near Spring Creek, Torquay, Victoria; T1025, with 19 mounted specimens A-R, labelled "*Limopsis insolita* Sow. Eocene Aldinga; Adelaide". The large specimens A-D (28 x 30 mm.) in the top row appear to be from the *Limopsis* bed at the top of the Blanche Point Marls, Aldinga Bay; other smaller specimens have the matrix of the "glauconitic greensands of the Adelaide Bore", i.e. the Upper Eocene greensands at a depth of 150-218 feet in Engineering and Water Supply Department Bore at Kent Town, Adelaide; T1032, with 10 specimens A-J in a growth series, labelled "*Limopsis insolita* Sowerby, Miocene? Aldinga Cliffs". The locality is presumably the *Limopsis* bed at the top of the Blanche Point Marls, Aldinga Bay.

Type Locality. Bird Rock Cliffs near Spring Creek, Torquay, Victoria; Jan Juc Formation, Oligocene.

Stratigraphic Range. Upper Eocene to Oligocene.

Limopsis maccoyi Chapman

(pl. 1, figs. 17-22)

1875. *Limopsis belcheri* McCoy, Prod. Pal. Vict., dec. 2, 25, pl. 19, figs. 8, 9 (*non* Adams and Reeve) (in part).

1886. *Limopsis belcheri* Tate, Trans. Roy. Soc. S. Aust., 8, 134 (*non* Adams and Reeve) (in part).

1911. *Limopsis maccoyi* Chapman, Proc. Roy. Soc. Vict., 23 (2), 421, pl. 83, fig. 2; pl. 85, fig. 8.

1955. *Limopsis maccoyi*; Ludbrook, Trans. Roy. Soc. S. Aust., 78, 24, pl. 1, fig. 10.

Description. Shell subtrigonal, obliquely ovate, moderately convex, umbo slightly to the anterior, small, acute, incurved; dorsal margin slightly curved, anterior and posterior margins curved, the posterior margin produced towards the ventral margin, ventral margin gently curved; hinge line arched, with as

many as 11 teeth on each side, teeth strong and high, slightly hooked; ligamental area small and broadly subtriangular, ligament pit large and deep; ornament of numerous narrow radial riblets with secondary riblets intercalating between them, crossed by less prominent concentric undulating ridges. Inner margin smooth, bevelled, and bounded on the inner side by a fine narrow ridge extending as far as the hinge on both sides; anterior adductor high, elongate-ovate, posterior adductor low and broadly ovate; pallial line entire, interior of shell inside the pallial line conspicuously radially striate.

Dimensions. T1023A length 20, height 19·5; T1023K length 20·5, height 18·5; T1027A length 18, height 20 mm.

Types. Lectotype (here designated) N.M.V. P12376, the specimen figured by McCoy pl. 19, fig. 8; syntypes N.M.V. P12377 (McCoy pl. 19, fig. 9), P12579, P12580, P12581 (figured Chapman pl. 83, fig. 2). No holotype was designated by Chapman, nor did he consider it necessary to redescribe the species described and figured by McCoy as *Limopsis belcheri* (Adams and Reeve). The two specimens from Balcombe Bay P12376, P12377, figured by McCoy, and the three P12579, P12580 (Grice's Creek) and P12581 (Gellibrand River) figured by Chapman, form the type series from which P12376 is selected as lectotype and Balcombe Bay designated type locality. Tate Collection hypotypes are T1023A, T1023C, T1023D, T1023K, T1027A, T1027E.

Material. The species is represented in the Tate Collection on two tablets T1023 and T1027. T1023 has 28 mounted specimens A-F from Muddy Creek, I-J from Camperdown, K-L, T-W from Gellibrand River, M-O, X-Z, a-b from Spring Creek, O-R from Mornington, S from Fyansford. G and H from Cheltenham are *Limopsis beaumariensis*; T1027 has 16 specimens A-P, all from "River Murray Cliffs", i.e. Cadell Marl Lens, Morgan.

Type Locality. Balcombe Bay, Balcombe Clay, Balcombian.

Stratigraphic Range. Jan Juc Formation to Dry Creek Sands; ?Upper Oligocene to Upper Pliocene.

Limopsis morningtonensis Pritchard

(pl. 1, figs. 11, 12, 13)

1875. *Limopsis aurita* McCoy, Prod. Pal. Vict., dec. 2, 23 (pars) (*non Arca aurita* Brocchi).

1886. *Limopsis aurita* Tate, Trans. Roy. Soc. S. Aust., 8, 134 (pars) (*non* Brocchi).

1901. *Limopsis morningtonensis* Pritchard, Proc. Roy. Soc. Vict., 14 (1), 24, pl. 2, figs. 6, 6a.

1911. *Limopsis morningtonensis*; Chapman, Proc. Roy. Soc. Vict., 23 (2), 420, pl. 83, fig. 1; pl. 85, fig. 7.

Description. Shell of moderate size, roundly quadrate, depressed, slightly oblique; umbo situated slightly to the anterior, small, prominent, acute, and incurved; anterior margin convexly rounded, posterior margin gently rounded with a tendency to angulation at the dorsal and ventral borders; slightly produced posteriorly. Hinge line straight or very slightly curved, half the length of the shell, ligamental area fairly long, ligament pit conspicuous; 5 to 9 anterior and 4 to 7 posterior teeth of unequal size. Ornament of strong flat concentric ridges of unequal strength, the ridges crossed by fine radial striations; inner margin smooth, broadly flattened.

Dimensions. T1020A (topotype) length 15·5, height 15 mm.; T1021A (Muddy Creek) length 19·5, height 18·5 mm.

Types. Holotype M.U.G.D. 1778; topotypes A.U.G.D. T1020 A-D; hypotypes T1020A, T1021A.

Material. There are two tablets in the Tate Collection: T1020 with 4 specimens (A-D) from "Eocene, Gellibrand River", the fifth specimen T1020E is *Limopsis chapmani* from Table Cape; T1021 with 9 specimens (A-I) in a growth series from Muddy Creek.

Type Locality. Gellibrand Marl, coast section below Curdie's Steps, Bairnsdalian.

Stratigraphic Range. Miocene, Batesfordian to Bairnsdalian.

Limopsis multiradiata Tate

(pl. 1, figs. 23-27)

1886. *Limopsis multiradiata* Tate, Trans. Roy. Soc. S. Aust., 8, 135, pl. 12, figs. 1a-b.

1897. *Limopsis multiradiata*: Harris, Cat. Tert. Moll. Brit. Mus., I, 346.

1911. *Limopsis multiradiata*: Chapman, Proc. Roy. Soc. Vict., **23** (2), 423, pl. 84, fig. 4; pl. 85, fig. 10.

Description. Shell suborbicular, slightly inequilateral and oblique, thick, moderately convex; umbones situated slightly to the anterior, prominent, incurved; shell slightly shouldered; anterior, posterior and ventral margins gently rounded, the posterior-ventral margin slightly produced; hinge line arched, fairly long, high, with 7 hooked teeth on each side; ligamental area long and conspicuous, concave; ligament pit large, equilateral, moderately deep with concentric striations. Juvenile shell smooth but for concentric ribs and very faint radials, adult shell ornamented with numerous fine bifurcating radial riblets broken by crenulated concentric growth lamellae producing a conspicuously tessellated surface; inner margin smooth, flattened; anterior adductor high, small, ovate; posterior adductor low, broadly ovate, pallial line inconspicuous.

Dimensions. A.U.G.D. T1031A length 10·5, height 9·5 mm.

Types. The type series T1031 consists of 17 specimens mounted in a growth series; T1031A is the holotype; a right valve which in Tate's figure pl. 12, fig. 1 has been reversed.

Material. Tablet T1031 only.

Type Locality. "Adelaide Bore", i.e. bore at Engineering and Water Supply Department, Kent Town, at 150-218 feet depth.

Stratigraphic Range. Upper Eocene (lower part).

Observations. The species also occurs in the Upper Eocene Blanche Point Marls of Aldinga Bay and in glauconitic sands at 75-80 feet depth at Adelaide Children's Hospital, North Adelaide, 1 mile from the type locality. The species occurs at a lower level than *L. chapmani*.

Family GLYCYMERIDAE

Genus GLYCYMERIS Da Costa, 1778

Subgenus GLYCYMERIS s.str.

Glycymeris (Glycymeris) cainozoica (Tenison Woods)

(pl. 1, figs. 28-34)

1877. *Cucullaea cainozoica* Tenison Woods, Pap. Roy. Soc. Tas. for 1876, 111.

1886. *Pectunculus cainozoicus*; Tate, Trans. Roy. Soc. S. Aust., 8, 136, pl. 10, figs. 8a, 8b; p. 137 (in part).

1888. *Pectunculus cainozoicus*; Johnston, Geol. Tas., pl. 31, figs. 13, 13a, b.

1897. *Pectunculus cainozoicus*; Harris, Cat. Tert. Moll. Brit. Mus., 1, 340 (? in part).

Description. Shell large, roundly trigonal to orbicular, solid, slightly oblique, globose, subequilateral, a little longer than high; umbones central, prominent, inflated, finely radially ribbed, strongly incurved, slightly overhanging the ligamental area; ligamental area of moderate size, arched, broad, with six grooves on each side; hinge area long, gently arched, with as many as 13 teeth on each side but usually encroached upon by the ligamental area; anterior adductor subovate, posterior adductor ovate with a ridge on the anterior side; inner margin finely denticulate, the denticulations sometimes smooth, but marked with fine closely spaced radial striae and fine concentric growth striae.

Dimensions. Topotype, T1055Q, length 33, height 31, inflation (one valve) 12 mm.

Types. Holotype Tas. Mus, Z204A, paratype Z204B. The type tablet in the Tate Collection coutains 19 specimens T1055 A-W, T1055C was figured by Tate and T1055B and C by Chapman and Singleton. T1055A-H, K-P are from Muddy Creek without any indication of whether from the lower (Muddy Creek Marl) or upper (Grange Burn Coquina) beds. T1055H, K-P are *Glycymeris halli* indistinguishable from topotypes collected by the writer from the Grange Burn Coquina. T1055J is from "Spring Creek", T1055 Q-T from Table Cape, and T, U-W from "Adelaide" (i.e. Kent Town Bore).

Material. The type tablet and tablet T1068 with specimens A-E from Cheltenham, Victoria, and F from Camperdown.

Type Locality. Table Cape, Tasmania; Freestone Cove Sandstone of Table Cape Group, Longfordian.

Stratigraphic Range. Upper Eocene to Upper Miocene. The oldest known occurrence of the species is in the Upper Eocene of Kent Town Bore, Adelaide, its youngest occurrence is in the Cheltenhamian of Beaumaris and also of the Bookpurnong Beds at their type locality, Loxton.

Glycymeris (Glycymeris) halli Pritchard

(pl. 1, figs. 35-36)

1886. *Pectunculus cainozoicus*, Tate, Trans. Roy. Soc. S. Aust., 8, 137 (in part), *non* Tenison Woods.

1897. *Pectunculus cainozoicus*, Harris, Cat. Tert. Moll. Brit. Mus., 1, p. 340 (in part), *non* Tenison Woods.

1903. *Glycymeris halli* Pritchard, Proc. Roy. Soc. Vict., **15** (2), 89, pl. 14, figs. 10-12; pl. 15, figs. 1, 2, 8, 9.

1925. *Glycymeris halli*; Chapman and Singleton, Proc. Roy. Soc. Vict., **37** (1), 40, pl. 3, fig. 23; pl. 4, fig. 15.

Description. Shell of moderate size, orbicular, tumid, thick, solid, equilateral; about as long as high; umbones central, tumid, incurved, overhanging the ligamental area; ligamental area small, short and very weakly grooved; hinge line long, gently curved, with about 12 teeth on each side; anterior adductor ovate, posterior adductor quadrately ovate; inner margin with numerous fine denticles. Surface ornamented with as many as 50 low slightly convex radial riblets with linear interspaces, each riblet finely radially striate; radial sculpture crossed by undulating growth folds.

Dimensions. T1055H length 23, height 22, inflation (both valves) 17 mm.

Types. Holotype M.U.G.D. 1783. On Tate's tablet T1055 labelled "*Pectunculus cainozoicus* T. Woods sp. Muddy Creek, (1) Table Cape, (2) Adelaide, (3) Spring Creek", specimens H, K-P are regarded as topotypes of *Glycymeris halli* from the upper beds at Muddy Creek (Grange Burn Coquina).

Material. T1055H, T1055K-P, which have been compared with topotypes in the G.S.S.A. Collection.

Type Locality. Grange Burn, between Forsyth's and Henty's, Grange Burn Coquina.

Stratigraphic Range. Kalimnan (Lower Pliocene).

Subgenus Grandaxinea Iredale, 1931

Glycymeris (Grandaxinea) granti Singleton

(pl. 2, figs. 3, 6)

1932. *Glycymeris* (*Grandaxinea*) *granti* Singleton, Proc. Roy. Soc. Vict., **44** (2), 294, pl. 24, figs. 10, 11.

Description. Shell large but not heavy, about as high as long, suborbicular tending to become irregularly orbicular in the adult; umbo subcentral, incurved, small; ligamental area relatively long and narrow, with 10 striae on each side, hinge line nearly straight in the middle but strongly arched at each end, with 5 or 6 anterior and 9 posterior teeth, scarcely curved and rather low and broad; anterior adductor subtrigonal, posterior adductor subovate, the shell within the pallial line and between the adductor scars excavate; inner margin nearly flat, weakly denticulate with about 20 denticles which become obsolete on either side. Surface ornamented with 33 to 37 radial costae crossed by concentric growth striae which are weaker on the ribs than in the interspaces, the costae tend to be angulate on the side and flattened in the middle appearing dichotomous when the shell is wet; ribbing on the anterior and posterior rather flattened dorsal areas discrepant with narrow ribs and wider interspaces particularly on the dorsal side.

Dimensions. T1071D length 53, height 53 mm.

Types. Holotype M.U.G.D. 1315, paratype M.U.G.D. 1316; hypotype Tate Collection T1071D.

Material. Tate's tablet T1071 labelled "*Pectunculus laticostatus* Quoy and Gaimard, Eocene, (1) Bird Rock Bluff; Muddy Creek", contains 3 specimens B, D and E from Muddy Creek, all of which may be identified as *G. (G.) granti.*

Type Locality. Muddy Creek, Hamilton, Victoria; Muddy Creek Marl, Balcombian to Bairnsdalian.

Stratigraphic Range. Balcombian to Bairnsdalian, Miocene.

Observations. The three species *G. (G.) granti, G. (G.) maccoyi* and *G. (G.) ornithopetra* are very difficult to separate. The fewer ribs (29 to 31), orbicular and more convex shape, and inconspicuous dorsal areas distinguish *maccoyi*; *ornithopetra* has 32 to 40 ribs which become narrow and more widely spaced on a posterior-dorsal area; *granti* has a broader hinge line, flattened dorsal areas, and more angulate ribs. Most of these differences could be attributed to ecological conditions. The lineage described by Singleton (1932, 295) should be reversed, the stratigraphic order being from Janjukian (Upper Oligocene) to Balcombian (Lower Miocene): *ornithopetra–maccoyi–granti.*

Glycymeris (Grandaxinea) maccoyi (Johnston)

(pl. 3, fig. 1)

1880. *Pectunculus MacCoyii* Johnston, Pap. Roy. Soc. Tas. for 1879, 41.

1885. *Pectunculus McCoyi* Johnston, Pap. Roy. Soc. Tas. for 1884, 199, 200.

1886. *Pectunculus McCoyii*; Tate, Trans. Roy. Soc. S. Aust., 8, 137.

1897. *Pectunculus laticostatus*; Harris, Cat. Tert. Moll. Brit. Mus., 1, 341 (in part).

1914. *Glycimeris maccoyi*; Chapman and Gabriel, Proc. Roy. Soc. Vict., **26** (2), 303, pl. 24, fig. 4 (*non* 1-3, 5).

1916. *Glycimeris maccoyi*; Chapman, Rec. Geol. Surv. Vict., 3 (4), pl. 67, fig. 4 (*non* 1-3, 5).

1925. *Glycymeris maccoyi*; Chapman and Singleton, Proc. Roy. Soc. Vict., **37** (1), 27, pl. 1, figs. 7a, 7b; pl. 4, fig. 5.

Description. Shell large, orbicular, convex, about as high as long, equilateral; dorsal margin short, slightly curved; anterior, posterior and ventral margins evenly curved; umbo central, small; ligamental area relatively long with about 8 striae on each side, hinge line fairly long and broadly arched with 8 teeth on each side; anterior adductor large, reniform; posterior adductor subtrigonal and ridged on the inner margin: pallial line entire, inner margin of shell flattened with 20 broad denticulations between the external radial ribs. Surface ornamented with 29 to 31 radial convex ribs separated by narrow interspaces, weaker and somewhat more widely separated on the anterior and posterior dorsal area, but without any discrepancy between the anterior and posterior.

Dimensions. T1066A length 42, height 42 mm.

Types. Neotype N.M.V. 13326; hypotype (topotype) T1066A.

Material. Of the two specimens mounted on Tate's tablet T1066, labelled "*Pectunculus McCoyii* R. M. Johnston, Eocene, Table Cape Tasmania" only specimen A is considered to be *Glycymeris maccoyi*, as redefined by Chapman and Singleton. T1066B is *Glycymeris ornithopetra* with discrepant ornament between the anterior and posterior dorsal areas.

Type Locality. Table Cape, Tasmania; Table Cape Group, Freestone Cove Sandstone, Longfordian.

Stratigraphic Range. Lower Longfordian (Lower Miocene).

Glycymeris (Grandaxinea) ornithopetra Chapman and Singleton

(pl. 2, figs. 1, 2, 4, 5; pl. 3, fig. 14)

1875. *Pectunculus laticostatus* McCoy, Prod. Pal. Vict., dec. 2, 26-27, pl. 19, figs. 10, 11, 14 (numbered 9 in error on plate (*non* 12, 13)); (*non* Quoy and Gaimard).

1886. *Pectunculus laticostatus* Tate, Trans. Roy. Soc. S. Aust., **8**, 137 (in part) (*non* Quoy and Gaimard).

1888. *Pectunculus McCoyi* Johnston, Geol. Tas., pl. 31, figs. 1, 1a, 1b (*non* 1c, 1d) (*non* Johnston, 1885).

1914. *Glycimeris maccoyi*; Chapman and Gabriel, Proc. Roy. Soc. Vict., **26** (2), 303, 304, pl. 24, figs. 2, 3 (*non* 1, 4, 5).

1925. *Glycymeris ornithopetra* Chapman and Singleton, Proc. Roy. Soc. Vict., **37** (1), 32, pl. 2, figs. 9a, 9b; pl. 4, fig. 7.

Description. Shell large, thick, convex, about as high as long, suborbicular but tending to become irregularly orbicular in the gerontic stage with the ventral margin tending to be produced on the umbonal-ventral axis and the posterior margin to become angulate; umbo subcentral, incurved, small; ligamental area short and high, with as many as 14 striae on each side; hinge broadly arched, encroached upon by the ligamental area, leaving about 8 arched teeth on each side. Anterior adductor pyriform, posterior adductor roundly quadrate, pallial line entire, inner margin of shell bevelled, with 24-28 denticulations corresponding to the intercostal spaces. Surface ornamented with from 32 to 40 radial costae crossed by concentric growth striae becoming more conspicuous and lamellose towards the ventral border; the radials are discrepant on the posterior-dorsal triangular area in which they are narrower and tending to become obsolete, the interspaces becoming correspondingly wider.

Dimensions. T1070A length 73, height 70 mm.

Types. Holotype N.M.V. 12465; hypotypes Tate Coll. T1066B, T1070A, T1071A, C.

Material. The species is represented on three tablets in the Tate Collection: T1066 labelled "*Pectunculus McCoyii* R. M. Johnston Eocene, Table Cape, Tasmania", on which specimen B is *G.* (*G.*) *ornithopetra*. T1070 labelled "*Pectunculus laticostatus* Quoy and Gaimard, Eocene, Spring Creek", with 9 specimens A-I, all topotypes. T1071 labelled "*Pectunculus laticostatus* Quoy and Gaimard. Eocene (1) Bird Rock Bluff; Muddy Creek". Two specimens A and C are from Bird Rock.

Type Locality. Bird Rock, Torquay, Victoria; Jan Juc Formation.

Stratigraphic Range. Janjukian to Longfordian, Upper Oligocene and Lower Miocene.

Subgenus TUCETONA Iredale, 1931

Glycymeris (Tucetona) convexa (Tate)

(pl. 3, figs. 15-20)

1886. *Pectunculus convexus* Tate, Trans. Roy. Soc. S. Aust., **8**, 138, pl. 11, figs. 7a, b.

1897. *Pectunculus convexus*; Harris, Cat. Tert. Moll. Brit. Mus., **1**, 342.

1914. *Glycimeris maccoyi* Chapman and Gabriel, Proc. Roy. Soc. Vict., **26** (2), 304, pl. 24, fig. 5 (*non* 1-4), *non* Johnston.

1916. *Glycimeris maccoyi* Chapman, Rec. Geol. Surv. Vict., 3 (4), pl. 67, fig. 5 (*non* 1-4), *non* Johnston.

1925. *Glycymeris concexa*; Chapman and Singleton, Proc. Roy. Soc. Vict., 37 (1), 38, pl. 2, figs. 16a, 16b, 17-20; pl. 4, figs. 12, 13.

1947. *Tucetona crama* Cotton, Rec. S. Aust. Mus., 8 (4), 660, pl. 20, figs. 1, 2.

1955. *Glycymeris (Tucetona) concexa*; Ludbrook, Trans. Roy. Soc. S. Aust., 78, 26.

Description. Shell large for the subgenus, thick, tumid, suborbicular, subequilateral, about as long as high; umbones central, approximate, incurved; ligamental area small, with 5 striae on each side, hinge area wide, strongly arcuate, with about 10 teeth on each side; anterior adductor subovate, posterior adductor subquadrate with a slight ridge on the anterior side below which the shell is excavate; inner margin bevelled, strongly denticulate with 20 intercostal denticulations; surface strongly ornamented with 22 to 24 rounded elevated costae equal to the concave interspaces, ribs and interspaces crossed by close set concentric growth striae; the ornament is weaker on the anterior and posterior dorsal areas.

Dimensions. Holotype, T1017C, length 33, height 31, inflation (one valve) 11 mm.

Types. Tate's type series T1017A-R mounted on a single tablet contains the holotype T1017C and 15 paratypes, all from "Muddy Creek" (upper beds).

Material. In addition to the type series, there is a tablet T1010 A-F with six well-preserved and typical specimens from "Cooke's Plains, 90-mile desert". The exact locality and formation from which these were obtained is at present uncertain.

Type Locality. Grange Burn Coquina, Muddy Creek, near Hamilton, Victoria: Kalimnan.

Stratigraphic Range. Kalimnan and Yatalan. In South Australia the species is present in the Pliocene generally: Norwest Bend Formation, Hallett Cove Sandstone and Dry Creek Sands.

Glycymeris (Tucetona) decurrens Chapman and Singleton

(pl. 3, figs. 9-10)

1925. *Glycymeris decurrens* Chapman and Singleton, Proc. Roy. Soc. Vict., **37** (1), 42, pl. 3, figs. 24a, 25b, 25a, 25b; pl. 4, fig. 16.

Description. Shell small, rather thin, subtrigonal to suborbicular, moderately depressed, equilateral, about as long as high; umbones very small, central, acute, opisthogyrous; ligamental area very small, hinge area deeply arcuate, with about 13 strong teeth on each side; anterior adductor ovate, posterior adductor roundly quadrate with a ridge on the anterior side; inner margin bevelled, with about 20 strong denticulations; surface ornamented with about 31 radial costae of even strength over the whole shell, somewhat flattened, crossed by regular concentric lines, more conspicuous in the interspaces than on the ribs.

Dimensions. T1065A, length 13·5, height 13·5 mm.

Types. Holotype N.M.V. 13332, paratype N.M.V. 13333; the two Tate Collection hypotypes T1065A, B.

Material. Tablet T1065, labelled "*Pectunculus McCoyii* R. M. Johnston, Miocene, Gippsland", has 2 left valves both juveniles. They are conspecific with topotypes from Muddy Creek and presumably came from Jemmy's Point Formation from which Chapman and Singleton (p. 43) recorded the species.

Type Locality. Forsyth's, Grange Burn, near Hamilton, Victoria; Grange Burn Coquina, Kalimnan.

Stratigraphic Range. Kalimnan, Lower Pliocene.

Glycymeris (Tucetona) gunyoungensis Chapman and Singleton

(pl. 3, figs. 5-8)

1875. *Pectunculus laticostatus* McCoy, Prod. Pal. Vict., dec. 2, 26, 27, pl. 19, figs. 12, 13 (*non* 9, 10, 10a, 11) (*non* Quoy and Gaimard).

1886. *Pectunculus laticostatus* Tate, Trans. Roy. Soc. S. Aust., **8**, 137 (in part) (*non* Quoy and Gaimard).

1886. *Pectunculus McCoyii* Tate, ibid. (in part) (*non* Johnston).

1888. *Pectunculus McCoyi* Johnston, Geol. Tas., pl. 31, figs. 1c, 1d (*non* 1, 1a, 1b); *non* Johnston, 1885.

1897. *Pectunculus laticostatus* Harris, Cat. Tert. Moll. Brit. Mus., **1**, 341 (in part) (*non* Quoy and Gaimard).

1914. *Glycimeris maccoyi* Chapman and Gabriel, Proc. Roy. Soc. Vict., **26** (2), 303, 304, pl. 24, fig. 1 (*non* 2-5); *non* Johnston.

1916. *Glycimeris maccoyi* Chapman, Rec. Geol. Surv. Vict., **3** (4), pl. 67, fig. 1 (*non* 2-5); *non* Johnston.

1925. *Glycymeris gunyoungensis* Chapman and Singleton, Proc. Roy. Soc. Vict., **37** (1), 23, pl. 1, figs. 5a, 5b, 6; pl. 4, fig. 4.

Description. Shell of moderate size, suborbicular, depressed, a little longer than high; umbo central, small, inconspicuous, slightly opisthogyrous; ligamental area small, with 4 striae on each side; hinge line of moderate length, arcuate, with 10 to 11 short and slightly uncinate teeth in each series; anterior adductor elongate-rhomboidal, posterior adductor sub-trapezoidal with a thin ridge on the anterior side; inner margin only slightly flattened, with 21 intercostal denticulations, interior of shell within the pallial line radially grooved. Surface ornamented with 33 radial costae, rounded, wider than interspaces, crossed by concentric growth lamellae which become more irregular and imbricating towards the ventral margin.

Dimensions. T1067b, length 29, height 27 mm.

Types. Holotype N.M.V. 13324, paratype N.M.V. 13325, hypotype T1067B, C, J.

Material. The species is represented in the Tate Collection by 20 examples mounted on tablet T1067 labelled "*Pectunculus McCoyii* Johnston, Eocene, Muddy Creek, Schnapper Point, Corio Bay, Gellibrand River, Fyansford". T1067A-D, G, H, J, K, N-P, R-T are from Muddy Creek, I from Schnapper Point, Q from Corio Bay, E-F from Gellibrand River, L-M from Fyansford.

Type Locality. Grice's Creek, Bairnsdalian.

Stratigraphic Range. Balcombian to Bairnsdalian.

Glycymeris (Tucetona) lenticularis (Tate)

(pl. 3, figs. 11-13)

1886. *Pectunculus lenticularis* Tate, Trans. Roy. Soc. S. Aust., 8, 138, pl. 11, fig. 1.

1925. *Glycymeris lenticularis*; Chapman and Singleton, Proc. Roy. Soc. Vict., 37 (1), 31, pl. 1, figs. 8a, 8b; pl. 4, fig. 6.

Description. Shell of moderate size, rather thin, orbicular, depressed, equilateral, a little longer than high; umbones small, approximate, incurved; ligamental area small, narrow, with 5 widely diverging striae on each side; hinge line long and roundly arched, with 12 teeth on each side; anterior adductor elongate-subovate, posterior adductor subquadrate, with a ridge on the anterior side; inner margin flattened, with 32 conspicuous denticulations; surface ornamented with usually from 30 to 50 fine radial costae crossed by frequent imbricating growth striae.

Dimensions. Holotype T1011 A-B, length 31, height 29, inflation (both valves) 12 mm.

Types. Holotype T1011A-B, both valves of a single specimen mounted separately on tablet. Tate's figure appears to be that of T1011B, the left valve; both valves were figured by Chapman and Singleton (pl. 1, figs. 8a, 8b); the tablet also contains 9 paratypes C-L in a growth series. Chapman and Singleton, who were under the impression that *G. lenticularis* was of Lower Miocene age, considered that T1011C and T1011C-K belonged to *G. gunyoungensis*, but this is not so, although all of these specimens have fewer ribs than the finely ribbed holotype.

Type Locality. "Adelaide" (Kent Town) Bore, at 150-218 feet in greensands equivalent to Blanche Point Marls.

Stratigraphic Range. South Maslin Sands and equivalents of Blanche Point Marls. Upper Eocene.

Observations. This species also occurs in foundation bores at Adelaide Children's Hospital at depths between 65 and 76 feet, mostly below the level at which *Limopsis chapmani* occurs (62-66 feet).

Glycymeris (Tucetona) subtrigonalis (Tate)

(pl. 3, figs. 2-4)

1886. *Pectunculus subtrigonalis* Tate, Trans. Roy. Soc. S. Aust., 8, 137, pl. 11, figs. 6a-6b.

1897. *Pectunculus subtrigonalis*; Harris, Cat. Tert. Moll. Brit. Mus., 1, 340.

1925. *Glycymeris subtrigonalis*; Chapman and Singleton, Proc. Roy. Soc. Vict., 37 (1), 34, pl. 2, figs. 10-12; pl. 4, fig. 8.

Description. Shell of moderate size, solid, roundly subtrigonal, subequilateral, convex, a little longer than high; ligamental area relatively small, with 6 deep striae on either side; hinge line fairly short, arcuate, with from 8 to 10 short, uncinate teeth in either series; anterior adductor subtrapezoidal, posterior adductor ovate, with a ridge on the anterior side; inner margin bevelled, with 17 denticulations; interior within the pallial line excavate and radially striate; surface ornamented with from 26 to 30 radial costae, rounded and separated by narrow interspaces crossed by concentric growth lamellae which become imbricating towards the ventral margin in adult shells.

Dimensions. Holotype T1069C, length 30, height 29, inflation (one valve) 9 mm.; paratype T1069D, length 32, height 31·5, inflation 9 mm.

Types. The type tablet T1069 contains the holotype T1069C and 11 paratypes T1069A-B, D-M.

Type Locality. Cadell Marl Lens, section C, Hundred of Cadell, 4 miles south of Morgan.

Stratigraphic Range. Lower Miocene, Batesfordian.

Family ARCIDAE

Genus ARCA Linné, 1758

Arca capulopsis Pritchard

(pl. 4, figs. 1-3)

1901. *Arca capulopsis* Pritchard, Proc. Roy. Soc. Vict., 14 (1), 23, pl. 2, figs. 1, 2.

Description. Shell elongate-trapeziform, subpyramidal, with a flat shallow medial sulcus from the umbo to near the ventral margin; hinge margin straight, ventral margin curved and approximately parallel to the hinge margin, anterior margin gently rounded, posterior margin concave, ventral margin gently curved, insinuated; posterior slope with a well-defined angular carina which delimits the concave posterior dorsal area; umbones widely separated, situated at the anterior one-third, small, slightly opisthogyrous; ligamental area large and wide, with one or two radiating grooves; hinge long and narrow with about 12 small transverse teeth under the umbo and 12 posterior and 6 anterior larger somewhat oblique teeth; adductor impressions not discernible; inner margin weakly crenulate. Surface ornamented with from 5 to 11 radial riblets on the posterior area and numerous fine radial riblets on the rest of the shell crossed and fimbriated by frequent growth lamellae which are weaker on the posterior area than on the rest of the shell.

Dimensions. T1064A, length 9, height 4·5 mm.

Types. Holotype M.U.G.D. 1773; topotypes A.U.G.D. Tate Collection T1064 A-D.

Material. Tablet T1064 labelled with the Tate MS. name "*Fossularca eminula*" containing 4 specimens, A-C, from Fyansford (topotypes of Pritchard's species) and D from Muddy Creek.

Type Locality. "Orphanage Hill, Geelong", Fyansford Clay, Bairnsdalian.

Stratigraphic Range. Miocene (Bairnsdalian). Pritchard (p. 23) observes that the species in the Pliocene ("Miocene") of Grange Burn is probably derived. T1064D on Tate's tablet has the appearance of a derived shell.

Arca pseudonavicularis Tate

(pl. 3, figs. 30-31)

1886. *Arca pseudonavicularis* Tate, Trans. Roy. Soc. S. Aust., 8, 139, pl. 11, fig. 8.

Description. Shell elongate-subtrapeziform, tumid, gaping ventrally; hinge margin straight, ventral margin slightly curved and excavate in the middle,

anterior margin gently rounded, posterior margin nearly straight; umbones at the anterior one-third, widely separated, acute, incurved; ligamental area large with radiating grooves typical of the genus; hinge long and narrow with numerous transverse teeth, all roughly transversely grooved; anterior adductor subtriangular, inner margin of valve smooth, pallial line distinct, area within pallial line finely striate. Surface ornamented with irregular radial riblets crossed on all but the posterior dorsal area by concentric fimbriating folds, on the posterior dorsal area the radial ornament is dominant, on the rest of the shell the concentric ornament dominates.

Dimensions. Holotype T1057A, length 27·5, height 12·5, inflation (one valve) 8 mm.

Types. The holotype T1057A and two paratypes T1027B, C, mounted on a single tablet.

Material. The type tablet only.

Type Locality. Adelaide (i.e. Kent Town) Bore at 150-218 feet, Upper Eocene.

Stratigraphic Range. Upper Eocene of Blanche Point Marls equivalents. Tate recorded (p. 139) that R. M. Johnston had the species from Table Cape, but there are no specimens to confirm this in the Tate material.

Genus Arcopsis von Koenen, 1885

(= *Fossularca* Cossmann, 1887)

Arcopsis dissimilis (Tate)

(pl. 5, figs. 26-30)

1886. *Barbatia dissimilis* Tate, Trans. Roy. Soc. S. Aust., 8, 140, pl. 11, figs. 4, 5.
1897. *Area (Fossularca) dissimilis*; Harris, Cat. Tert. Moll. Brit. Mus., 1, 336.

Description. Shell small, transversely oblong, tumid, convex anteriorly but with a flattened triangular posterior dorsal area; hinge margin straight, oblique; ventral margin gently rounded, anterior margin gently rounded, posterior margin nearly straight or very gently curved meeting the hinge margin at an angle of about 120°; umbones near the anterior one-third, fairly wide apart, prominent, incurved, overhanging the ligamental area; ligamental area rather narrow with a triangular pit beneath the umbo; hinge area slightly arcuate with about 8 anterior and 14 posterior teeth all slightly oblique; adductor impressions faint but apparently triangularly ovate with a narrow ridge on the inner side; pallial line entire, inner margin simple. Surface ornamented on the left valve with radial riblets crossed by concentric striae which interrupt the riblets in a tessellated pattern; the pattern is absent on the right valve except in the triangular dorsal areas, elsewhere the surface of the shell is pitted in a concentric and radial pattern as if these were scars left after the tessellated riblets had rubbed off.

Dimensions. T1059D, length 7·5, height 5 mm.

Types. The type tablet T1059 has 18 mounted specimens A-T from Eocene of Aldinga and Adelaide Bore, there being no distinction between the two locali-

ties. The syntypes figured are the left valve T1059D and the right valve T1059L; both are stated to have come from "Adelaide bore".

Material. The type tablet. The species also occurs in Adelaide Children's Hospital Bore 5 at 63-76 feet (G.S.S.A. Collection).

Type Locality. Adelaide (i.e. Kent Town) Bore at 150-218 feet, Upper Eocene.

Stratigraphic Range. Upper Eocene of Blanche Point Marls and their equivalents in and near the city area, Adelaide.

Observations. The stratigraphic range of *Arcopsis* is Upper Cretaceous to Recent, with greatest abundance in the Eocene (Reinhart, 1935, p. 32).

Genus Barbatia Gray, 1842

Subgenus Barbatia s. str.

Barbatia (Barbatia) consutilis Tate

(pl. 3, figs. 24-27)

1886. *Barbatia consutilis* Tate, Trans. Roy. Soc. S. Aust., 8, 142, pl. 2, fig. 15.
1897. *Arca* (*Barbatia*) *consutilis*; Harris, Cat. Tert. Moll. Brit. Mus., 1, 332.

Description. Shell moderately large, narrowly ovate-oblong, twice as long as high, with a medial-ventral depression; ventral margin more or less parallel to the hinge margin; anterior margin rounded, posterior margin rounded, produced; ventral margin gently rounded, insinuate; posterior slope slightly flattened; umbones at the anterior one-quarter, prosogyrous; ligamental area narrow, faintly grooved; hinge margin straight, with numerous oblique teeth; adductor scars not clear, internal margin smooth. Surface ornament consists of numerous fine radial threads crossed by concentric growth folds and fine concentric threads with granules at their intersections with the radials, particularly in the immature shell.

Dimensions. Holotype T1053A, length 41, height 20, inflation (one valve) 8 mm.

Types. The type tablet contains the holotype T1053A and 12 paratypes T1053B-N; most are from "Eocene, Muddy Creek"; T1053C is from Cheltenham, Victoria, and T1053K from "R. Murray Cliffs". The figure of the holotype has been reversed on Tate's plate.

Material. Tablet T1053 only.

Type Locality. Muddy Creek, Hamilton, Victoria; Muddy Creek Marl, Balcombian to Bairnsdalian, Miocene.

Stratigraphic Range. Lower Miocene (Batesfordian) to Lower Pliocene (Kalimnan). The species is recorded by Dennant (1889, p. 50) from both upper and lower beds at Muddy Creek.

Observations. Specimen T1053C from Cheltenham may not belong to the species. It bears some resemblance to a specimen of *Barbatia simulans* T1054B from Norwest Bend. A range of specimens is, however, lacking to enable the two specimens to be determined with any confidence.

Barbatia (Barbatia) limatella Tate

(pl. 3, figs. 21-23)

1886. *Barbatia limatella* Tate, Trans. Roy. Soc. S. Aust., 8, 141, pl. 10, fig. 2.

Description. Shell large, oblong-ovate, tumid, medially depressed in juvenile specimens, ventral margin more or less parallel to the hinge margin, anterior margin rounded, posterior margin rounded and meeting the hinge margin at an obtuse angle, ventral margin gently rounded, usually insinuated medially, posterior slope convex; umbones at the anterior one-fifth, prosogyrous; ligamental area very narrow, with four divaricating furrows; hinge margin straight with numerous small transverse teeth in the centre becoming oblique and larger towards the ends; anterior adductor elongate-pyriform, posterior adductor rhomboidal; internal margin showing faint fine denticulations in oblique light. Surface ornamented with numerous fine dichotomously dividing radial threads crossed by fine concentric threads and imbricating growth folds.

Dimensions. Holotype T1048B, length 50, height 28, inflation (one valve) 9 mm.

Types. Tate's tablet T1048 contains the holotype T1048B and 10 paratypes T1048A, C-L; T1048A has been marked (in Howchin's handwriting) "fig'd", but the measurements given by Tate and the figure, although it is a very poor one, appear to correspond more closely to T1048B which is accepted as the holotype.

Material. Tablet T1048 only.

Type Locality. "Adelaide", i.e. Kent Town, Bore at 150-218 feet depth.

Stratigraphic Range. Upper Eocene of Blanche Point Marls and their equivalents in subsurface sections at Adelaide.

Barbatia (Barbatia) pumila Tate

(pl. 3, figs. 15-18)

1886. *Barbatia pumila* Tate, Trans. Roy. Soc. S. Aust., 8, 142, pl. 10, fig. 7.

1897. *Arca (Barbatia) pumila*; Harris, Cat. Tert. Moll. Brit. Mus., 1, 334.

Description. Shell small, ovate, convex, inequilateral, ventral margin diverging slightly in a posterior direction from the hinge margin; hinge margin straight, anterior and posterior margins rounded, ventral margin gently rounded; umbones at the anterior one-third, prosogyrous; ligamental area narrowly triangular and slightly encroaching on the hinge at about the middle of the posterior side; hinge with numerous transverse teeth; anterior adductor small and high, subovate; posterior adductor small, elongate-subtriangular; inner margin crenulated, particularly on the posterior. Surface ornamented with flatly rounded radial riblets, broader than the interspaces, wider and more prominent on the posterior slope where they are bifurcated by a longitudinal sulcus; riblets crossed and granulated by numerous concentric threads and concentric growth folds.

Dimensions. T1052D, length 8, height 5·7 mm.

Types. There is no clear indication on the tablet as to which is the figured specimen and T1052D is selected as lectotype. T1052D has been marked (in Howchin's writing) 'fig'd', but this is a small specimen not agreeing with Tate's measurement or very well with the type figure. The type figure has presumably been reversed, as with other figures of Tate's types. Tablet T1052 contains also 14 paratypes T1052A-C, E-N, of which all are from Muddy Creek but P and Q, which are from Gellibrand River.

Material. Tablet T1052 only.

Type Locality. Muddy Creek, Hamilton, Victoria; Muddy Creek Marl. (Balcombian to Bairnsdalian). In his type description Tate states that the species is "not uncommon in the upper beds at Muddy Creek, Hamilton". Tate's tablet T1052, Harris (1897, p. 334) and Dennant (1889, p. 50), Dennant and Kitson (1903, p. 120) all clearly state that the species occurs only in the lower beds.

Stratigraphic Range. Muddy Creek Marl and Gellibrand Marl; Miocene (Balcombian to Bairnsdalian).

Subgenus Acar Gray, 1857

Barbatia (Acar) celleporacea Tate

(pl. 5, figs. 10-14)

1886. *Barbatia celleporacea* Tate, Trans. Roy. Soc. S. Aust., 8, 141, pl. 10, fig. 10.
1897. *Arca (Barbatia) celleporacea*; Harris, Cat. Tert. Moll. Brit. Mus., 1, 332.
1947. *Acar coma* Cotton, Rec. S. Aust. Mus., 8, (4), 657, pl. 20, figs. 25, 26.
1955. *Barbatia (Acar) coma*: Ludbrook, Trans. Roy. Soc. S. Aust., 78, 22.

Description. Shell of moderate size, elongate-oblong, rather compressed, with a shallow umbo-ventral depression; ventral margin divergent from the hinge margin in a posterior direction; anterior margin gently curved; posterior margin nearly straight, oblique, forming an obtuse angle with the hinge margin; posterior slope with a sharply defined carina delimiting a flat posterior area; ventral margin slightly insinuate; umbones prosogyrous, situated at the anterior one-quarter; hinge margin straight, hinge with a narrow cardinal area and teeth transverse in the middle, becoming more oblique towards the ends, all grooved across the top; both the anterior and posterior adductor scars are drop-shaped and raised above the level of the shell interior; internal margin crenulated between the external ribs. Surface ornamented with strongly fimbriate concentric lamellae crossed by radial riblets which on the adult shell develop into hollow elongated tubercles on the posterior carina, the ornament elsewhere being tegulate.

Dimensions. Holotype T1062A-B, length 26, height 10, inflation (both valves) 7·5 mm.

Types. The type tablet contains the holotype, a pair of valves, T1062A, B, mounted separately, and 14 paratypes T1062C-P.

Material. The type tablet only.

Type Locality. "Schnapper Point, Mornington, Victoria." There is nothing on Tate's tablet to distinguish specimens from "Schnapper Point" from those from Muddy Creek. As Tate specifically states (l.c. 6, 157) that the figured specimen is from Schnapper Point, Balcombe Bay must be accepted as the type locality.

Stratigraphic Range. Lower Miocene to Upper Pliocene, from Lower Miocene of the Freestone Cove Sandstone of Table Cape to the Upper Pliocene of the Dry Creek Sands. The species occurs in both the Muddy Creek Marl (Balcombian to Bairnsdalian) and Grange Burn Coquina (Kalimnan) at Muddy Creek.

Barbatia (Acar) crustata Tate

(pl. 5, figs. 19-25)

1886. *Barbatia crustata* Tate, Trans. Roy. Soc. S. Aust., 8, 140, pl. 2, fig. 16.
1897. *Arca (Barbatia) crustata*; Harris, Cat. Tert. Moll. Brit. Mus., 1, 333.

Description. Shell small, elongate-rhomboidal, tumid, with a conspicuous medial sulcus and corresponding shallow sinus in the ventral margin, anterior side relatively short and narrow, posterior margin concave, forming an obtuse angle with the hinge margin; posterior slope with a well-defined carina delimiting a concave posterior area; ventral margin insinuate, diverging from the hinge margin in a posterior direction; umbones at the anterior one-fifth, prosogyrous; straight, long; hinge with about 7 anterior and 14 posterior oblique teeth, the posterior series sometimes at a lower angle than the anterior series; adductor impressions large, the anterior subpyriform, the posterior elongate-subtriangular, inner margin plain. Surface strongly ornamented with concentric lamellae, about 14 per mm. in the middle of the shell, crossed and granulated by fine radial riblets, about 7 per mm.

Dimensions. Holotype T1061B, length 7·3, height 4·3 mm.

Types. Tablet T1061 contains 9 specimens A-J of which only T1061B was marked by Tate as from Norwest Bend. As only Norwest Bend is referred to in the original description, it must be assumed that this is the type locality and T1061B the holotype. The type figure is so poor and probably reversed that it is difficult to relate it to any particular specimen on the tablet. T1061B has been marked 'fig'd' and 'holotype' by later workers. Specimens T1061A and C-J are paratypes from Muddy Creek. Tablet T1060 has 10 paratypes: A-O from Gellibrand River, E from Fyansford, and F-J from "River Murray".

Material. T1061A-J, T1060A-J.

Type Locality. In describing the species Tate referred only to "Oyster beds of the River Murray Cliffs at North-West Bend". It is unlikely that the small shell came from the hard sandy limestone of the Norwest Bend Formation; both the preservation and stratigraphic affinities suggest that if it came from Norwest Bend it was taken from the Morgan Limestone underlying the Norwest Bend Formation. Specimens have been collected from the Cadell Marl Lens at the type section of the Morgan Limestone from which Tate's specimens T1060F-J are presumed also to have come. The species is stated by Dennant (1889, p. 50) to occur only in the older (Miocene) beds at Muddy Creek.

Stratigraphic Range. Miocene, Batesfordian to Bairnsdalian.

Barbatia (Acar) simulans Tate

(pl. 3, figs. 28-29)

1886. *Barbatia simulans* Tate, Trans. Roy. Soc. S. Aust., 8, 142, pl. 11, fig. 10.
1897. *Arca (Barbatia) simulans*; Harris, Cat. Tert. Moll. Brit. Mus., 1, 333.

Description. Shell of moderate size, transversely trapezoidal, relatively high, moderately inflated, very inequilateral, with a weak broad medial sulcus particularly in juvenile specimens; anterior margin rounded and meeting the hinge margin at an obtuse angle; posterior margin concave, forming an angle of 130° with the hinge margin; posterior slope with a somewhat rounded

carina delimiting the concave posterior area; ventral margin weakly insinuate, slightly curved; umbones situated at the anterior one-quarter, prosogyrous, well separated; hinge area fairly narrow, hinge margin straight, with numerous oblique slightly grooved teeth; anterior adductor ovate, posterior adductor not visible because of mounting of specimens; inner margin finely crenulate. Surface ornamented with fine radial riblets weaker and finer in the medial area, those in the posterior being broader and longitudinally sulcate, all crossed and granulated by concentric growth ridges weaker than the radials.

Dimensions. Holotype T1054A, length 34, height 18, inflation (one valve) 7 mm.

Types. Tablet T1054 contains the holotype T1054A and three paratypes T1054C, E, F from Muddy Creek, two paratypes T1054B, D from Norwest Bend, and one paratype T1053 from "Well near Blanchetown".

Material. Tablet T1054 only.

Type Locality. Muddy Creek, Hamilton, Victoria; Muddy Creek Marl, Balcombian to Bairnsdalian.

Stratigraphic Range. Miocene (Balcombian) to Lower Pliocene (Kalimnan).

Subgenus Cucullaearca Conrad, 1865

Barbatia (Cucullacarca) equidens (Tate)

(pl. 4, figs. 4-7)

1886. *Area equidens* Tate, Trans. Roy. Soc. S. Aust., 8, 139, pl. 11, fig. 9.
1897 *Area equidens*: Harris, Cat. Tert. Moll. Brit. Mus., 1, 331.

Description. Shell small, elongate-subtrapeziform, with a marked umbo-ventral depression and a corresponding broad insinuation in the ventral margin, hinge margin straight, oblique, anterior margin meeting the hinge margin at 90° but sloping away in a gentle curve to meet the ventral margin, posterior margin insinuated in the concave posterior-dorsal area then roundly curving to the ventral margin; umbones situated at the anterior one-third, wide apart, prominent, strongly incurved and slightly overhanging the ligamental area; ligamental area long and wide with a long narrow oblique triangular pit posterior to the umbo obliquely striated with as many as ten close-set striae, the ligamental area otherwise is smooth or faintly striate; hinge area straight dorsally and gently curved ventrally with seven or eight teeth on each side usually more or less horizontal near the centre and becoming more oblique towards the interior and posterior borders, all the teeth are conspicuously grooved on both sides. Anterior adductor triangularly-ovate, posterior adductor subquadrate, both adductors weakly buttressed on the inner side; pallial line entire, inner margin of shell simple. Surface of shell strongly ornamented with concentric imbricating ridges and radial riblets which are interrupted by the growth ridges in the adult stages; there is a tendency to discrepancy between the two valves, the ornament on the left valve being fimbriate, that on the right valve cancellate, but becoming fimbriate near the ventral margin.

Dimensions. Holotype T1058C, length 9·9, height 6, inflation (one valve) 4 mm.

Types. Tate's tablet consists of the holotype T1058C and 17 paratypes T1058A-B, D-T, all from "Eocene, Adelaide Bore". As in other cases the figure of the holotype (pl. 11, fig. 9) has been reversed.

Material. The type tablet. Both Tate and Harris recorded the species also from Aldinga. It occurs in Bore 5 at Adelaide Children's Hospital at 63-64 feet and 72-73 feet (G.S.S.A. Collection).

Type Locality. Adelaide (i.e. Kent Town) Bore at 150-218 feet, Upper Eocene.

Stratigraphic Range. Upper Eocene of Blanche Point Marls and their equivalents in bores in and near the city area, Adelaide.

Subgenus PLAGIARCA Conrad, 1875

Barbatia (Plagiarca) cainozoica (Tate)

(pl. 5, figs. 1-9)

1886. *Macrodon cainozoicus* Tate, Trans. Roy. Soc. S. Aust., 8, 143, pl. 10, fig. 4.
1897. *Arca (Plagiarca) cainozoica*; Harris, Cat. Tert. Moll. Brit. Mus., 1, 335.

Description. Shell small, subrhomboidal, with a broad depression from the umbo to the ventral margin and a corresponding very slight shallow sinus in the ventral margin; anterior side short, acutely angulate, posterior side elongated, with a slight concave triangular dorsal area and truncated by a well-defined posterior slope; hinge margin straight, ventral margin slightly curved with a median insinuation; umbo situated at the anterior one-quarter, prominent, incurved; ligamental area narrow with a few faint striae; hinge very slightly curved with about five short, oblique teeth on the anterior and thirteen slightly oblique or laminar teeth on the posterior side of the edentulous central area, all teeth finely rugose; anterior adductor ovate, posterior adductor subquadrate; inner margin smooth, bevelled. Surface ornamented with concentric flat ridges carrying fine radial threads sometimes producing a fimbriate ornament towards the ventral margin; the ridges are separated by deep grooves narrower than the ridges.

Dimensions. Holotype T1056C, length 27·5, height 10, inflation (one valve) 5 mm.

Types. The holotype T1056C and 26 paratypes T1056A-B, D-U, T1063A-H.

Material. Tate's type series is mounted on two tablets. The first T1056 carries 10 specimens from Muddy Creek, 4 from Schnapper Point, 1 from "Corio Bay" and 4 from "Adelaide". Of these T1056B is marked "fig'd", but it is obvious from the dimensions of the type figure that the specimen is T1056C. As with others, the figure has been reversed. Tablet T1063 carries 3 specimens, A-C, from Cellibrand River and 5, D-H, from "River Murray" (i.e. Cadell Marl Lens).

Types Locality. Muddy Creek, Hamilton, Victoria; Muddy Creek Marl, Balcombian to Bairnsdalian.

Stratigraphic Range. Upper Eocene of Blanche Point Marls equivalents beneath Adelaide; Miocene (Batesfordian to Bairnsdalian) in Victoria.

Genus ANADARA Gray, 1897

Anadara interclathrata Ludbrook (ex Tate) sp. nov.

(pl. 4, figs. 8-10)

1893. *Barbatia interclathrata* Tate in Tate and Dennant, Trans. Roy. Soc. S. Aust., **17**, (1), 224 (*nom. nud.*).

Description. Shell small, thick but fragile, broadly trapeziform, tumid, with a shallow umbo-ventral depression; ventral margin parallel to the hinge margin, anterior margin very gently rounded and meeting the hinge margin at about 90°, posterior margin curved and meeting the hinge margin at a little more than 90°, ventral margin insinuated, anterior and posterior slopes somewhat flattened; umbones fairly widely separated, at the anterior one-third, prosogyrous; ligamental area long and fairly wide, triangular; hinge margin straight, with numerous teeth becoming slightly oblique towards the extremities; adductor impressions obscured, inner margin coarsely denticulate. Surface ornamented with 22 to 24 strong radial costae somewhat narrower than the interspaces crossed by fine frequent concentric threads which are stronger on the interspaces than on the ribs.

Dimensions. Holotype T1051A, length 12, height 8, inflation (one valve) 4 mm.

Types. The holotype and T1051A and 5 paratypes T1051B-F.

Material. The type tablet only.

Type Locality. Spring Creek, Torquay, Victoria, believed from the matrix to be Jan Juc Formation.

Stratigraphic Range. Janjukian, ?upper Oligocene.

Observations. The species though named and recorded was not described by Tate. Its rarity as an ancestral species of the genus *Anadara* and its restricted occurrence necessitates its description.

Family CUCULLAEIDAE

Genus CUCULLAEA Lamarck, 1801

Cucullaea adelaidensis Tate

(pl. 4, figs. 11-15)

1886. *Cucullaea adelaidensis* Tate, Trans. Roy. Soc. S. Aust., 8, 144, pl. 11, fig. 14.

1932. *Cucullaea adelaidensis*; Singleton, Proc. Roy. Soc. Vict., 44, (2), 304, pl. 26, figs. 21-24.

Description. Shell of moderate size, rather thin, obliquely trapezoidal, inequilateral, tumid, longer than high; hinge margin straight, meeting the anterior and posterior margins at 120°, posterior margin straight, produced; anterior margin rounded, ventral margin gently rounded; umbones large, prominent, strongly incurved and overlapping the ligamental area, situated slightly to the anterior; ligamental area small, with as many as five divaricating furrows meeting under the umbo at a low angle; hinge area narrow, long, with from three to five longitudinal laminar teeth on the posterior and anterior sides and

about nine small, transverse, central teeth increasing in size and obliquity outwards, teeth rugose on the upper and lower surfaces; anterior adductor elongate-subtriangular, posterior adductor pyriform, bounded by a thickened but not plate-like ridge; pallial line entire, area within radially striate, inner margin more or less coarsely denticulate. Surface ornamented with fine narrow radial riblets developing a median linear groove towards the ventral margin, crossed by frequent undulating growth laminae; the ornament on the left valve is finer than that on the right and is always more definite on the juvenile shell.

Dimensions. Holotype T1047B, length 43, height 30, inflation (one valve) 15 mm.

Types. The holotype T1047B and eight paratypes T1047A, C-J mounted on a single tablet, most of these were taken from the tablet for photographing and remounted by Singleton so that the interior of the shell could be examined and figured, T1047B is the specimen measured and figured by Tate, although Chidley's figure, like many others in the Tate papers, has been reversed.

Material. The type tablet T1047 only.

Type Locality. Adelaide (i.e. Kent Town) Bore at 150-218 feet; Upper Eocene.

Stratigraphic Range. Upper Eocene equivalents of Blanche Point Marls.

Cucullaea corioensis McCoy

(pl. 4, figs. 16-24)

1876. *Cucullaea corioensis*; McCoy, Prod. Pal. Vict., 3, 32, pl. 27, figs. 4, 5 (*?non* figs. 3, 5a).

1886. *Cucullaea corioensis*; Tate, Trans. Roy. Soc. S. Aust., 8, 144.

1888. *Cucullaea corioensis*; Johnston, Geol. Tas., pl. 29, figs. 4, 4a.

1897. *Cucullaea corioensis*; Harris, Cat. Tert. Moll. Brit. Mus., 1, 336.

1932. *Cucullaea corioensis*; Singleton, Proc. Roy. Soc. Vict., 44, (2), 300, pl. 26, figs. 10a, b.

Description. Shell moderately large, heavy, obliquely trapezoidal, inequilateral, tumid, longer than high, left valve overlapping the right valve ventrally, hinge margin straight, meeting the anterior and posterior margins at 110°, anterior margin rounded, posterior margin slightly produced; umbo large, prominent, strongly incurved, with a shallow median radial depression, overhanging the ligamental area; ligamental area broad, flattened, with as many as four deep furrows on either side; hinge line moderately long, straight, with four longitudinal teeth in each series and a median series of 14 or more transverse to oblique teeth more or less encroached upon by the ligamental area. Anterior adductor subtriangular, posterior adductor subquadrate with an elevated plate extending from the pallial line to below the umbo on the posterior side, pallial line entire, area within the pallial line radially striate, inner margin crenulate. Surface ornamented with fine flat radiating riblets separated by linear grooves, in the adult shell the riblets have a median longitudinal groove; radial riblets crossed by fine concentric growth lines more or less undulating over the riblets.

Dimensions. T1049A (topotype), length 41, height 33, inflation (left valve) 17 mm.

Types: Lectotype N.M.V. 12236, paratype N.M.V. 12237; hypotypes Tate Collection T1046 A, B, E; T1049 A, C; T1050 A, B, C.

Material. The Tate material consists of three tablets; T1046 with 8 mounted specimens in a growth series from "River Murray Cliffs"- Cadell Marl Lens, 4

miles downstream from Morgan; T1049 with two mounted specimens A from "Eocene, Spring Creek" and B from Cheltenham; T1050 with 10 specimens in a growth series A-B, E-M, from Muddy Creek, no indication being given of whether they were from the Pliocene or Miocene, 2 specimens C, D from Table Cape.

Type Locality. Bird Rock Cliffs, near Spring Creek, Torquay; Janjukian.

Stratigraphic Range. ? Upper Oligocene to Upper Pliocene.

ACKNOWLEDGMENTS

The author's most grateful thanks are due to Miss Lynette Linke of the Palaeontology Section of the Geological Survey of South Australia for photographing the specimens, a task made difficult by the fact that they are mounted in rows on wooden tablets. Some stratigraphic details were clarified by Messrs. R. C. Glenie and P. E. Bock of the Geological Survey of Victoria. Information on the type series of *Limopsis beaumariensis* and *L. maccoyi* was provided by Mr. T. A. Darragh of the National Museum of Victoria.

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Explanation of Plates

Plate 1

1–9 *Limopsis chapmani* Singleton
1. Complete specimen T1032B view of right valve; Aldinga, Blanche Point Marls, "Limopsis Bed" Upper Eocene to Lower Oligocene.
5. T1032B dorsal view.
2. Complete specimen T1032C, view of left valve; Aldinga, as T1032B.
3. Left valve T1025C, interior view; Aldinga, as T1032B.
4. Left valve T1025A, exterior view; Aldinga, as T1032B.
6. Complete specimen T1025E, view of left valve; "Adelaide" (Kent Town) Bore, Upper Eocene.
7. Right valve T1025H, interior view; Kent Town Bore, as T1025E.
8. Complete specimen, topotype T1022A, view of left valve, "Spring Creek", Bird Rock, Jan Jue Formation, Upper Oligocene.
9. Left valve T1022E topotype, interior view.

10, 14, 15, 16 *Limopsis beaumariensis* Chapman
10. Right valve T1023G, topotype, "Cheltenham" (Beaumaris), Black Rock Sandstone, Cheltenhamian, Upper Miocene.
16. Left valve T1023H, topotype.
14. Left valve T1030B, "Gippsland Lakes", Jemmy's Point Formation, Kalimnan, Lower Pliocene.
15. Complete specimen T1030A, mounted with valves separated, "Gippsland Lakes", as T1030B.

11–13 *Limopsis morningtonensis* Pritchard
11. Topotype T1020A; Gellibrand Marl, Gellibrand River, Bairnsdalian.
12. T1020E. Freestone Cove Sandstone, Table Cape, Longfordian.
13. T1021A. Muddy Creek Marl, Muddy Creek, Balcombian to Bairnsdalian.

17–22 *Limopsis maccoyi* Chapman
17. Right valve, T1023A, somewhat rounded, Muddy Creek, Muddy Creek Marl.
18. Left valve, T1023C, interior view; Muddy Creek Marl.
19. Left valve, T1023D, an oblique and rather depressed specimen; Muddy Creek Marl.
20. Right valve, T1023K, Gellibrand Marl, Gellibrand River.
21. Right valve, T1027A; "River Murray Cliffs", Cadell Marl Lens, 4 miles downstream from Morgan, Batesfordian.
22. Left valve, T1027E; Cadell Marl Lens.

23–27 *Limopsis multiradiata* Tate
23. Holotype, T1031A, "Adelaide" (Kent Town) Bore, Upper Eocene. X 2·5.
26. Holotype X 1.
24. Paratype, T1031L; Kent Town Bore. X 2·5.
27. T1031L. X 1.
25. Paratype, T1031K; Kent Town Bore. X 2·5.

28–34 *Glycymeris* (*Glycymeris*) *cainozoica* (Tenison Woods)
28. Left valve, T1055Q, topotype; Freestone Cove Sandstone, Table Cape, Longfordian.
29. Right valve, T1055E; Muddy Creek Marl.
30. Right valve, T1055C; Muddy Creek Marl.
31. Left valve, T1068B; "Cheltenham" (Beaumaris), Black Rock Sandstone, Cheltenhamian.
32. Right valve, T1068C, Cheltenhamian.
33. Left valve, T1068F; "Camperdown" (Lake Bullen Meri), Gellibrand Marl, Bairnsdalian.
34. Left valve, T1055U; "Adelaide" (Kent Town) Bore, Upper Eocene.

35–36 *Glycymeris* (*Glycymeris*) *halli* Pritchard.
35. T1055L, immature specimen; ?Grange Burn Coquina, Muddy Creek, Kalimnan.
36. T1055K, complete specimen (immature); ?Grange Burn Coquina, Muddy Creek.

(*All figures natural size except* 23, 24, 25)

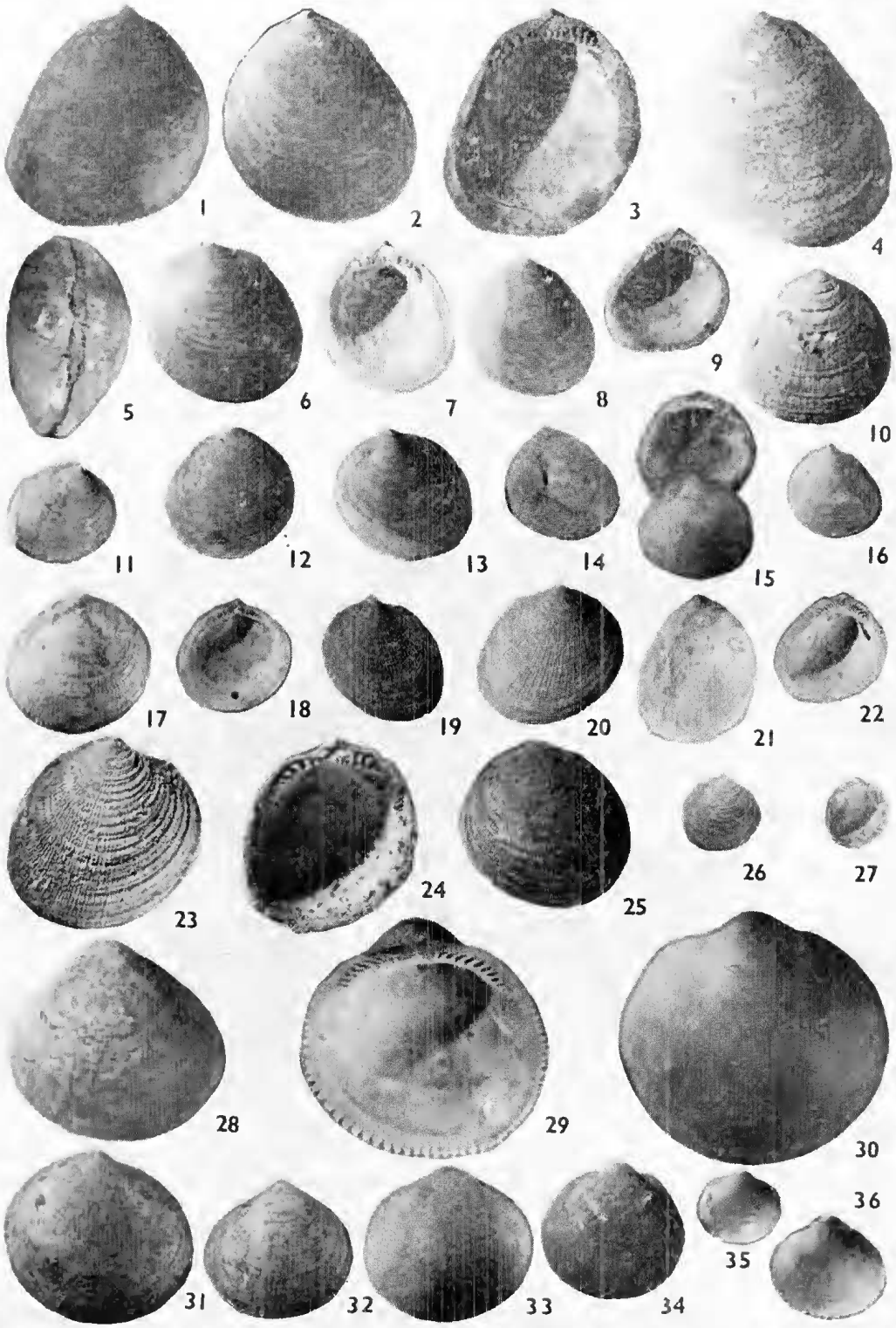
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Plate 2

1, 2, 4, 5 *Glycymeris* (*Grandaxinea*) *ornithopetra* Chapman and Singleton.

1. Topotype T1070A; produced ventrally; Bird Rock, Jan Juc Formation, Janjukian.
2. Topotype T1071C, complete specimen.
4. Topotype T1071A, round form, exterior view.
5. Topotype T1071A, interior view.

3, 6 *Glycymeris* (*Grandaxinea*) *granti* Singleton.

3. Topotype T1071D, exterior view.
6. Topotype T1071D, interior view. Muddy Creek Marl, Muddy Creek, Balcombian to Bairnsdalian.

(*All figures natural size*)

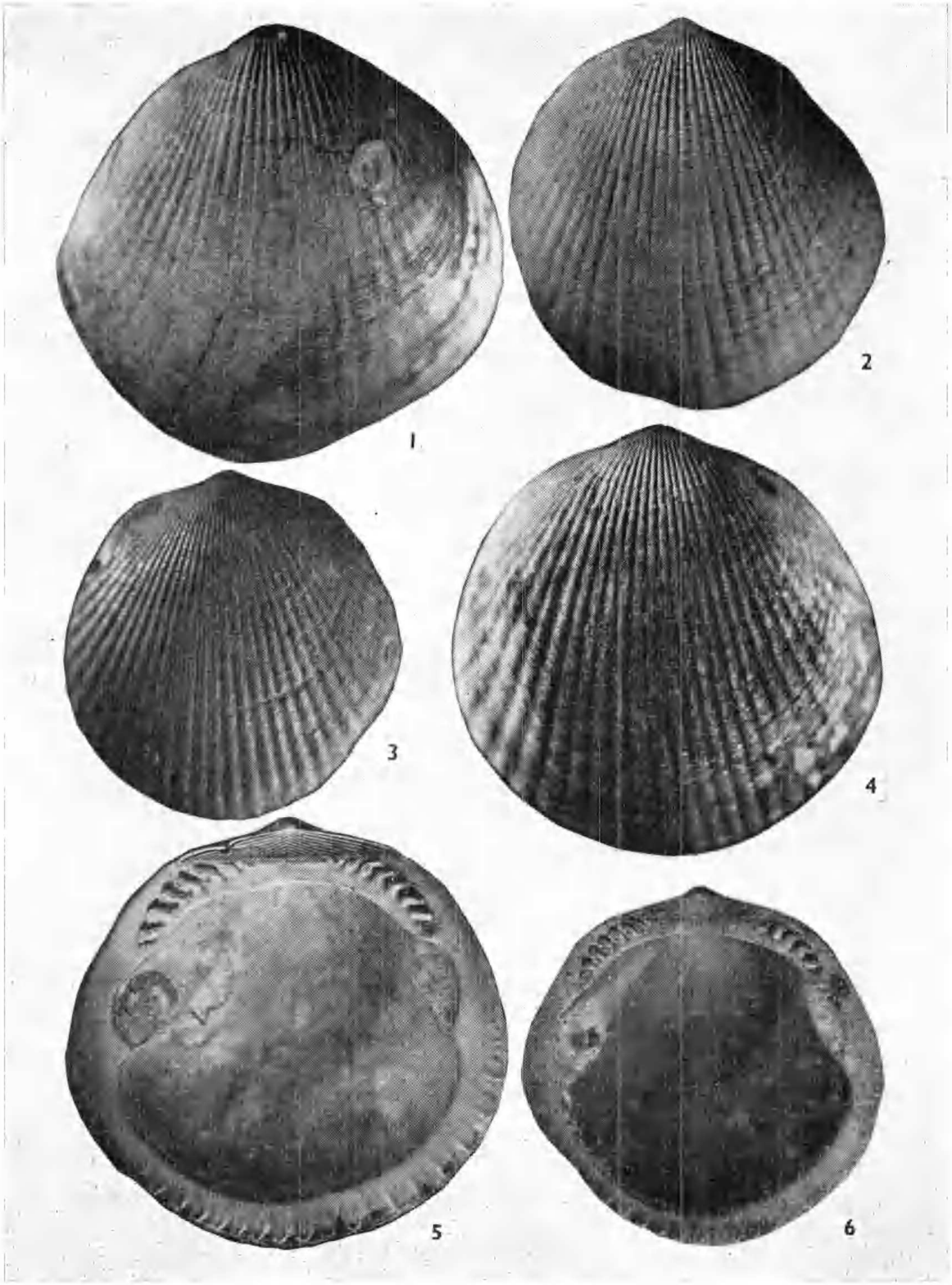
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PLATE 3

1 *Glycymeris* (*Grandaxinea*) *maccoyi* (Johnston).
1. Topotype T1066A, Freestone Cove Sandstone, Table Cape, Longfordian.

2–4 *Glycymeris* (*Tucetona*) *subtrigonalis* (Tate).
2. Holotype T1069C; Cadell Marl Lens, 4 miles south of Morgan, Batesfordian.
3. Paratype T1069E; Cadell Marl Lens.
4. Paratype T1069A, round form; Cadell Marl Lens.

5–8 *Glycymeris* (*Tucetona*) *gunyoungensis* Chapman and Singleton.
5. Topotype T1067I; "Schnapper Point"; Balcombe Clay, Balcombe Bay, Balcombian.
6. T1067C, Muddy Creek Marl, Balcombian to Bairnsdalian.
7. T1067B, Muddy Creek Marl.
8. T1067J, Fyansford Clay, Fyansford, Bairnsdalian.

9–10 *Glycymeris* (*Tucetona*) *decurrens* Chapman and Singleton.
9. T1065A, "Gippsland", ?Jemmy's Point Formation, Kalimnan.
10. T1065B from same locality.

11–13 *Glycymeris* (*Tucetona*) *lenticularis* (Tate).
11. Holotype T1011A, "Adelaide" (Kent Town) Bore, Upper Eocene.
12. Paratype T1011B, Kent Town Bore.
13. Paratype T1011D, Kent Town Bore.

14 *Glycymeris* (*Grandaxinea*) *ornithopetra* Chapman and Singleton.
14. T1066B, Freestone Cove Sandstone, Table Cape, Longfordian.

15–20 *Glycymeris* (*Tucetona*) *convexa* (Tate).
15. Holotype T1017C; Grange Burn Coquina, Muddy Creek, Kalimnan (Lower Pliocene).
16. Paratype T1017A.
17. Paratype T1017N (immature).
18. Paratype T1017D.
19. Paratype T1017K (immature).
20. Paratype T1017G (juvenile).

21–23 *Barbatia* (*Barbatia*) *limatella* Tate.
21. Holotype T1048B; left valve, "Adelaide" (Kent Town) Bore, Upper Eocene.
22. Paratype T1048A, right valve; Kent Town Bore.
23. Paratype T1048D, left valve; Kent Town Bore.

24–27 *Barbatia* (*Barbatia*) *consutilis Tate.*
24. Holotype T1053A; Muddy Creek Marl, Muddy Creek.
25. Paratype T1053D, left valve; Muddy Creek Marl.
26. Paratype T1053B, right valve; Muddy Creek Marl.
27. Paratype T1053N, right valve; Muddy Creek Marl.

28–29 *Barbatia* (*Acar*) *simulans* Tate.
28. Holotype T1054A, right valve; Muddy Creek Marl, Muddy Creek.
29. Paratype T1054D, left valve; "Norwest Bend".

30–31 *Arca pseudonavicularis* Tate.
30. Holotype T1057A, right valve; "Adelaide" (Kent Town) Bore, Upper Eocene.
31. Paratype T1057B, left valve; Kent Town Bore.

(*All figures natural size*)

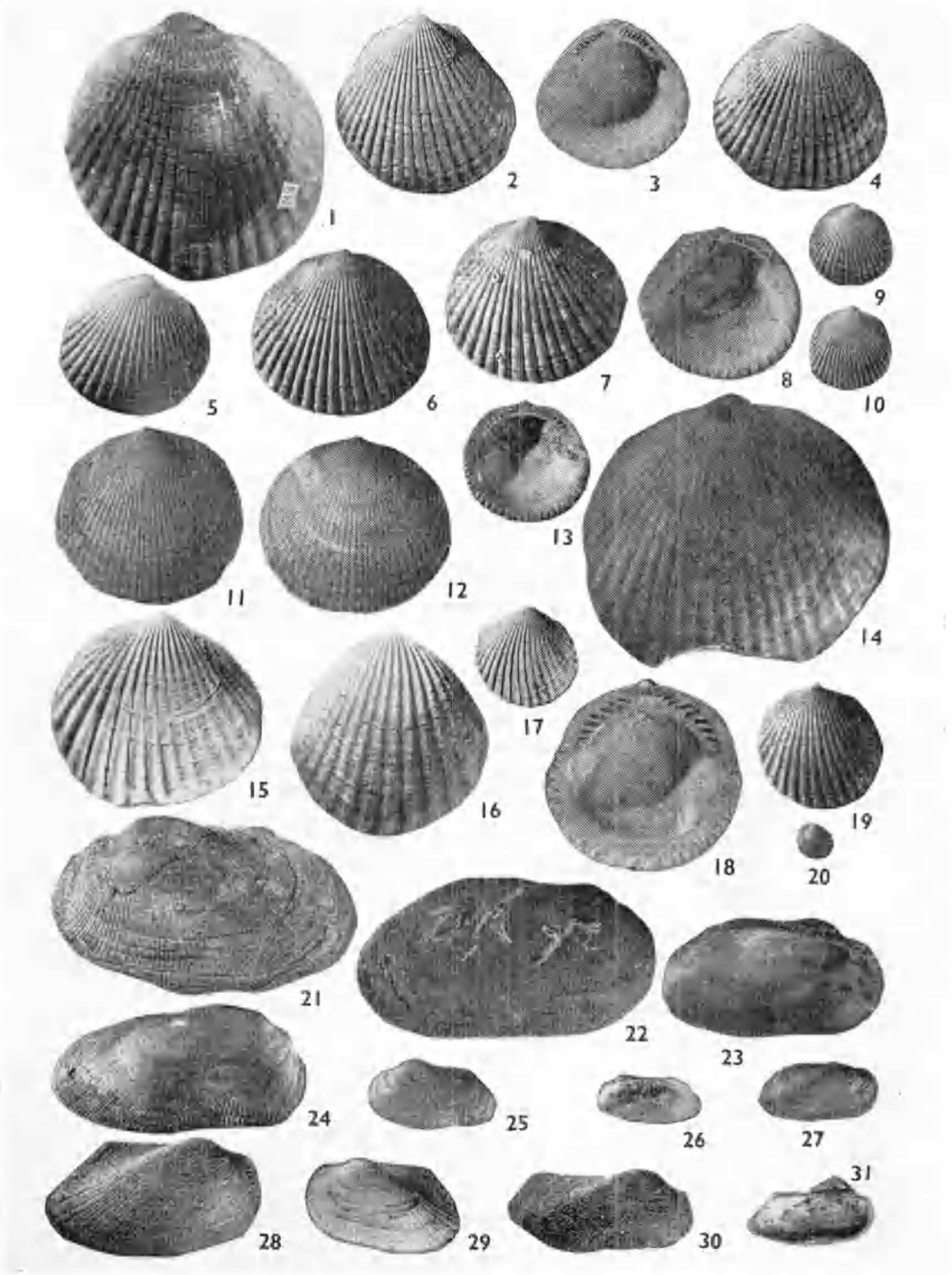
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Plate 4

1–3 *Arca capulopsis* Pritchard.

1. Topotype T1064A, right valve; Fyansford Clay, Fyansford, Bairnsdalian. X 3·3.
2. Topotype T1064C; Fyansford Clay. X 3·3.
3. T1064D; Muddy Creek, ?Grange Burn Coquina. X 3.

4–7 *Barbatia (Cucullaearca) equidens* Tate.

4. Holotype T1058C, left valve; "Adelaide" (Kent Town) Bore, Upper Eocene. X 4.
5. Paratype T1058K; Kent Town Bore. X 4.
6. Paratype T1058P; Kent Town Bore. X 4.
7. Paratype T1058Q; Kent Town Bore. X 4.

8–10 *Anadara interclathrata* Ludbrook.

8. Holotype T1051A, left valve; Jan Juc Formation, Bird Rock, Janjukian (Upper Oligocene). X 3.
9. Paratype T1051D; Jan Juc Formation. X 3.
10. Paratype T1051F; Jan Juc Formation. X 3.

11–15 *Cucullaea adelaidensis* Tate.

11. Paratype T1047A, left valve; "Adelaide" (Kent Town) Bore, Upper Eocene. X 1.
12. Holotype T1047B, right valve; Kent Town Bore. X 1.
13. Paratype T1047E, X 1; 14. Paratype T1047F, X 1; 15. Paratype T1047D, X 1.

16–24 *Cucullaea corioensis* McCoy.

16. T1049A, left valve, topotype, Jan Juc Formation, Bird Rock, Janjukian. X 1.
17. T1046A; Cadell Marl Lens, 4 miles south of Morgan, Batesfordian. X 1.
18. T1049C; Beaumaris, Cheltenhamian. X 1.
19. T1050C; Freestone Cove Sandstone, Table Cape, Longfordian. X 1.
20. T1046E; Cadell Marl Lens; 21. T1046B, Cadell Marl Lens, X 1; 22. T1046C, Cadell Marl Lens, X 1.
23. T1050B; Muddy Creek Marl, Balcombian to Bairnsdalian. X 1.
24. T1050A; Muddy Creek Marl. X 1.

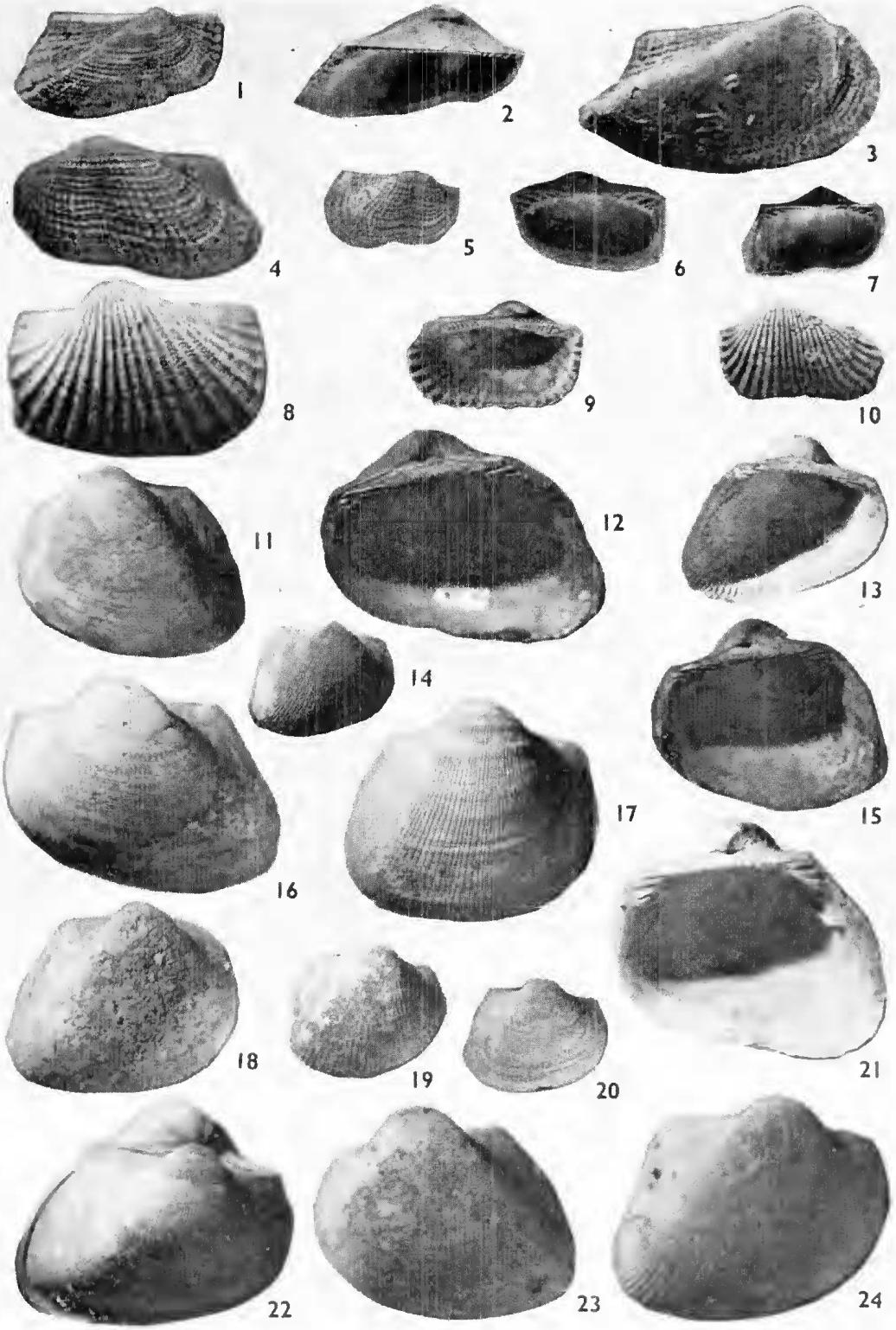
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PLATE 5

1–9 *Barbatia* (*Plagiarca*) *cainozoica* (Tate).

1. Holotype T1056C, right valve; Muddy Creek Marl, Muddy Creek, Balcombian to Bairnsdalian. X 2.
2. Paratype T1056E, complete specimen; Muddy Creek Marl. X 2·5.
3. Paratype T1056D; Muddy Creek Marl. X 2.
4. Paratype T1063B; Gellibrand Marl, Gellibrand River, Bairnsdalian. X 2·5.
5. Paratype T1063F; Cadell Marl Lens, 4 miles south of Morgan, Batesfordian. X 3.
6. Paratype T1063E; Cadell Marl Lens. X 3.
7. Paratype T1056M; "Corio Bay", Fyansford Clay, Bairnsdalian. X 3.
8. Paratype T1056T; "Adelaide" (Kent Town) Bore, Upper Eocene. X 3.
9. Paratype T1056S; Kent Town Bore. X 3.

10–14 *Barbatia* (*Acar*) *celleporacea* Tate.

10. Holotype T1062A, left valve; "Schnapper Point", Balcombe Clay, Balcombe Bay, Balcombian. X 1.
11. Holotype T1062B, right valve. X 1.
12. Paratype T1062N; Balcombe Bay. X 1.
13. Paratype T1062O; Balcombe Bay. X 1.
14. Paratype T1062D; complete specimen, Balcombe Bay. X 1.

15–18 *Barbatia* (*Barbatia*) *pumila* Tate.

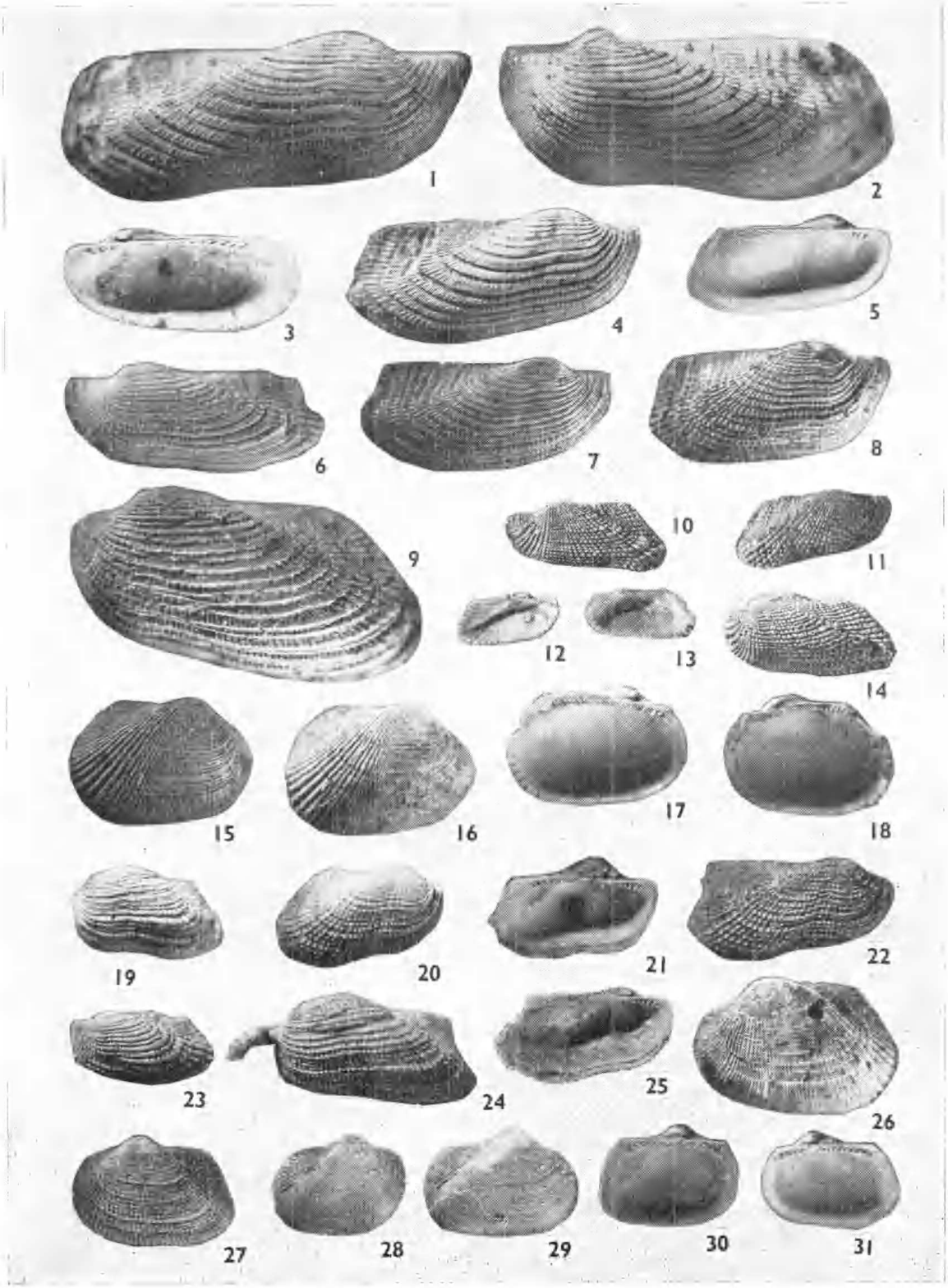
15. Lectotype T1052D, right valve; Muddy Creek Marl, Muddy Creek. X 3.
16. Paratype T1052F; Muddy Creek Marl. X 3.
17. Paratype T1052J; Muddy Creek Marl. X 3.
18. Paratype T1052K; Muddy Creek Marl. X 3.

19–25 *Barbatia* (*Acar*) *crustata* Tate.

19. Holotype T1061B, left valve; Muddy Creek Marl, Muddy Creek. X 3.
20. Paratype T1060H; Cadell Marl Lens, 4 miles south of Morgan, Batesfordian. X 3.
21. Paratype T1061F; Muddy Creek Marl. X 3.
22. Paratype T1060A; Gellibrand Marl, Gellibrand River, Bairnsdalian. X 3.
23. Paratype T1060J; Cadell Marl Lens. X 3.
24. Paratype T1061E; Muddy Creek Marl. At the anterior end is an attached foraminifer *Carpenteria proteiformis* Goës. X 3.
25. Paratype T1060B; Gellibrand Marl, Gellibrand River. X 3.

26–30 *Arcopsis dissimilis* (Tate).

26. Paratype T1059B, left valve; Blanche Point Marls, either at Aldinga or their equivalents in Kent Town Bore. X 4.
27. Syntype T1059D, left valve; 28. Syntype T1059L, right valve, Kent Town Bore, Upper Eocene. X 3.
29. Paratype T1059N. X 3·3.
30. Paratype T1059R. X 3·3.
31. Paratype T1059S. X 3·3.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